Total Pages—4

4th SS—PHY(Core-VIII) (Reg)

2019

PHYSICS

(*Mathematical Physics* - III)

[Core]

Paper – VIII

Full Marks : 60

Time : $2\frac{1}{2}$ hours

Answer from **both** the Groups as directed

The figures in the right-hand margin indicate marks

GROUP – A

Answer **all** questions : 3 × 4

1. Write the necessary condition for a function $f(z)$ to be Analytic.

2. Write the Dirichlet condition for a fourier series.

(*Turn Over*)

3. Find the fourier sine transform of $\frac{1}{x}$.

4. Dirac Delta function.

GROUP – B

Answer any **four** questions :

5. (*a*) State and explain convolution theorem on fourior transform.

   (*b*) Find the fourier cosine transform of

$$f(x) = e^{-ax}$$

6 + 6

6. (*a*) Write the laplace transform of Bessel function $J_0(x)$ and $J_1(x)$.

   (*b*) Find the inversa laplace transform of

   (*i*) $\frac{3s}{2s+9}$

   (*ii*) Evaluate $L^{-1}\left[\frac{e^{-s}-3e^{-3s}}{s^2}\right]$

6 + 3 + 3

7. Show that the function

$$f(z) = \sqrt{|xy|}$$

satisfies Cauchy-Riemann equation at the origin but is not analytic at that point. 12

8. (*a*) Define Singularity. Find the Singularity of

$$f(z) = \sin\frac{1}{z}$$

(*b*) Find the pole of

$$f(z) = \sin\left(\frac{1}{z-a}\right)$$

(*c*) Evaluate the residue of

$$\frac{z^2}{(z-1)(z-2)(z-3)}$$

at $z = 1, 2, 3$ and infinity and show that their sum is zero. 3 + 3 + 6

Total Pages—3

4th SS—PHY(Core-IX)
(Reg)

2019

PHYSICS

(*Elements of Modern Physics*)

[Core]

Paper – IX

Full Marks : 60

Time : $2\frac{1}{2}$ hours

Answer **all** questions from Group - A and any **four** questions from Group - B

The figures in the right-hand margin indicate marks

GROUP – A

Answer **all** questions : 4 × 3

1. Using Uncertainty relation explain 'why electrons cannot exist inside the nucleus'.

2. Write a short note on Nuclear reaction cross -section.

(*Turn Over*)

3. Explain excitation and ionisation potentials of an atom.

GROUP – B

Answer any **four** questions : 12 × 4

4. What is Photoelectric effect ? In the experiment of photoelectric effect the stopping potentials are V_1, V_2 and V_3 for frequencies f_1, f_2 and f_3 respectively. Draw graph between these values. How can you use this graph to calculate Threshold frequency, work function and Planck's constant ? 2 + 2 + 3 + 3 + 2

5. Derive Rutherford's formula of scattering of alpha-particles and give the expression for scattering cross-section. 6 + 6

6. Derive Planck's radiation formula and obtain Wein's displacement law and Rayleigh jeans law from it. 6 + 3 + 3

7. What do you mean by dual nature of radiation and

(*Continued*)

matter ? Describe Davisson and Germer experiment to verify the wave nature of electron.
2 + 7 + 3

8. Give the basic assumptions of Gamow's theory of alpha-decay. Derive the relation between decay constant and kinetic energy of alpha-particle. 3 + 9

9. With a neat diagram discuss the functions of each components of a nuclear reactor and also explain its principle and working. 4 + 8

Total Pages—3

4th SS—PHY (Core-X)
(Reg)

2019

PHYSICS

(*Analog Systems and Applications*)

[Core]

Paper – X

Full Marks : 60

Time : $2\frac{1}{2}$ hours

Answer **all** questions

The figures in the right-hand margin indicate marks

GROUP – A

1. Answer *all* questions : 3 × 4

(*a*) Write a short note on solar cell.

(*b*) Explain the classification of Class-A, Class-B and Class-C Amplifiers.

(c) Discuss Barkhausen's criterion for self oscillation in details.

(d) What do you mean by CMRR and Slew Rate of an OP-Amp ?

GROUP – B

Answer **all** questions : 12 × 4

2. Explain briefly the fabrication of PN junction. Give an idea about its Barrier formation. Highlight its static resistance. 5 + 5 + 2

Or

Discuss the construction and working of a Half wave rectifier. Calculate its efficiency and ripple factor. 2 + 3 + 4 + 3

3. Explain the characteristics of npn transistor in CB and CE configuration. Hence explain its current gains. Find out relations between them. 3 + 3 + 4 + 2

Or

Discuss the different methods of biasing of transistor by giving special emphasis to voltage devider method. 3 + 3 + 6

4. Explain the construction, working and frequency response of a RC coupled amplifier. 3 + 4 + 5

Or

Discuss the construction, operation and output wave form of a Colpitts oscillator. Determine its frequency of oscillation. 2 + 4 + 2 + 4

5. Write short notes on : 4 + 4 + 4

(*i*) Open-loop gain

(*ii*) Closed-loop gain

(*iii*) Virtual ground of an OP-Amp.

Or

Explain mathematically the OP-Amp as 6 + 6

(*a*) Adder

(*b*) Intigrator.

Total Pages—6 **4th SS—MATH(GE-IV)(Reg)**

2019

MATHEMATICS

(*Algebra and Advanced Algebra*)

[Generic Elective]

Paper – IV

Full Marks : 80

Time : 3 hours

Answer **all** questions

The figures in the right-hand margin indicate marks

The symbols and notations used in this questions
are of their usual meaning

1. Answer *all* questions : 4×4

(*a*) Prove that vectors (a, b), (c, d) are linearly dependent if and only if $ad = bc$.

(*b*) Prove that in a group the elements a and a^{-1} have same order.

(c) Find by Lagrange's formula, the interpolating polynomial which corresponds to the following data :

x	-5	-1	0	2
$f(x)$	87	7	-3	-1

(d) Evaluate $\operatorname{div}(r^3\vec{r})$ where $r^2 = x^2 + y^2 + z^2$.

2. (a) If S is a non-empty subset of a vector space V, prove that 8

1. $[S] = S$ if and only if S is a subspace of V

2. $[[S]] = [S]$.

(b) Using row operations find the inverse of the matrix

$$A = \begin{bmatrix} 1 & -1 & 2 \\ 0 & 2 & 3 \\ 3 & -2 & 4 \end{bmatrix}.$$ 8

Or

(c) Let a linear transformation $T : V_2 \to V_3$ be defined by $T(x_1, x_2) = (x_1 + x_2, 2x_1 - x_2, 7x_2)$. Let $B_1 = \{e_1, e_2\}$ and $B_2 = \{f_1, f_2, f_3\}$ be the standard bases of V_2 and V_3 respectively. Determine the matrix $(T : B_1, B_2)$. 8

(*d*) Find the eigen vectors of the following matrix :

$$A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}.$$ 8

3. (*a*) Show that the six elements in the set S_3 of all permutations of the set $S = \{1, 2, 3\}$ form a non-abelian group under the binary operation composition of functions. 8

(*b*) Prove that a non-empty subset H of the group G is a subgroup of G if and only if 8

1. $a, b \in H \Rightarrow a\,b \in H$
2. $a \in H \Rightarrow a^{-1} \in H$

Or

(*c*) Prove that any subgroup of a cyclic group is itself a cyclic group. 8

(*Turn Over*)

(*d*) Prove that there is a one-to-one correspondence between any two right coset of H in G. 8

4. (*a*) Compute the integral

$$\int_0^1 \frac{dx}{1+x^2}$$

by Simpson's $\frac{1}{3}$ rule and then use it to compute the value of π. 8

(*b*) Evaluate $f(0 \cdot 33)$ using Newton's forward difference formula with given data 8

x	0·3	0·4	0·6	0·7
$f(x)$	0·6179	0·6554	0·6915	0·7580

Or

(*c*) Evaluate

$$\int_0^1 \sqrt{1-x^3}\, dx$$

by the Trapezoidal rule taking $n = 6$. 8

(*Continued*)

(*d*) From the data given in the table construct the difference table and compute $f(21)$ by Newton's backward difference formula : 8

x	0	5	10	15	20
$f(x)$	1·0	1·6	3·8	8·2	15·4

5. (*a*) Find the equation of the tangent plane and normal line to the surface $yz - zx + xy = -5$ at the point $(1, -1, 2)$. 8

(*b*) If $\vec{a}$ be a constant vector and $\vec{r}$ is the position vector, show that 8

(*i*) $\text{div}\,(\vec{a} \times \vec{r}) = 0$

(*ii*) $\text{curl}\,(\vec{a} \times \vec{r}) = 2\vec{a}$

Or

(*c*) Prove that

$$\text{curl}\,(f\,\vec{F}) = \text{grad}\, f \times \vec{F} + f\ \text{curl}\,\vec{F}$$ 8

(*Turn Over*)

(*d*) A particle moves along the curve $x = 2t^2$, $y = t^2 - 4t$, $z = 3t - 5$. Find the components of the velocity and acceleration at time $t = 1$ in the direction $\hat{i} - 3\hat{j} + 2\hat{k}$. 8

Total Pages—3

4th SS—PHY (SEC-II) (Reg)

2019

PHYSICS

(*Renewable Energy and Energy Harvesting*)

[SEC]

Paper – II

Full Marks : 40

Time : 2 hours

Answer **all** questions

The figures in the right-hand margin indicate marks

GROUP – A

1. (*a*) What is ocean biomass ? Explain it. 4

(*b*) Explain in detail solar distillation with example. 4

(*Turn Over*)

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GROUP – B

Answer all questions

2. Give an overview of wave energy systems. Discuss the locations for wave-energy converters. 6 + 2

Or

What are the fossil fuels ? Discuss different types and uses of it. 3 + 3 + 2

3. What are solar cells ? How assembles of solar cells are used ? 5 + 3

Or

What is a solar tracker ? Give the advantages and disadvantages of solar tracking systems. 3 + 3 + 2

4. What is a wind turbine ? Discuss different electrical mechanism in wind turbine. 4 + 4

Or

Give a brief explanation of geothermal resources. 8

5. What do you mean by tidal energy ? What are the technologies used to obtain tidal energy ? 2 + 6

Or

Explain in brief the hydropower technology and discuss different types of hydroelectric plants. 4 + 4
